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ABSTRACT

A comparison of two projects involving CAI was made and the advantages and disadvantages of the approaches employed at each installation during their developmental and operational phase was made. The two projects are in Kansas City, Missouri, and Wakulla County, Florida. Both installations are located in public schools and were originally funded through Title III of the ESEA act. The original plan of the Kansas City project was to develop a series of short, half-hour, single concept enrichment lessons. Each of these lessons was designed such that a student would bypass a sequence if his performance was on the pretest indicates he had already mastered the concepts involved, thus minimizing the time spent in remedial lessons. The Wakulla County project attempted to upgrade and maintain student achievement at a satisfactory level by providing individualized instruction via CAI. Two primary goals of the project were (1) to implement computer-assisted instruction in mathematics and reading for southern rural students, and (2) develop and implement oral language materials to add standard speech patterns to the colloquial patterns of the students. The results of both methods indicated that the students held a favorable attitude toward CAI. Results in Wakulla indicated that across the board overall improvements in performance from fall 1968 to spring 1969 were attained with the most substantial increases reflecting the concentration of CAI treatment at the second and third grade levels. Both projects were particularly different with respect to staffing, operations, and a philosophy of curriculum development. This comparison emphasizes a need to visit more than one installation before forming an opinion of what CAI can and cannot do. (CK)

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# A Comparison of Two Public School Computer-Assisted Instruction Projects

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## Introduction

In 1963 Stanford first began its efforts in CAI. Today, many such projects are in operation servicing thousands of students each year. Probably no two of these projects are alike with respect to facilities, staffing, operations, and curriculum. Frequently, the determination of such issues is dictated by the particular circumstances in which the project is to exist. Many times, however, there will be several choices regarding these issues that require decisions to be made either in the planning phase or early operational stages of the project. Sometimes, the choices available at a particular point are contingent upon decisions made earlier.

In the near future, many new projects involving CAI will be conceived and implemented. It is, therefore, critical at this time to study some already existing projects in order to investigate how best to implement and operate computer-assisted instruction. This paper is a comparison of two such projects and discusses the advantages and disadvantages of the approaches employed at each installation during their developmental and operational phases. Hopefully, such a discussion will prove beneficial to those involved in designing a new CAI project.

The two projects involved are in Kansas City, Missouri and Wakulla County, Florida. These particular projects were selected due to the first author's experience as a teacher-author for Kansas City's Project and, later as a graduate assistant at Florida State University's CAI Center. Both installations are located in public schools and were

originally funded through Title III of the Elementary and Secondary Education Act. At least a part of the curriculum of both projects dealt with basic arithmetic skills. Also, an IBM 1500 Instructional System was the computer employed at each installation. This, however, is about the extent of the similarity between the two projects as is evident from the brief descriptions and following discussions.

## A Brief History of Kansas City's CAI Project

Kansas City's CAI project received its initial funding in February of 1968, through Title III of the Elementary and Secondary Education Act. A curriculum staff of eight classroom teachers with little or no prior experience with computers was identified and trained to write supplementary and enrichment lessons in eighth grade math and science, and code them for use on the computer. Additional staff members included a project director, systems manager, programmer, and two secretaries. Several faculty members and a part-time graduate student from the University of Missouri at Kansas City (UMKC) were employed as consultants in curriculum development, evaluation, and to train the writing staff. In August of 1968, an IBM 1500 instructional system with 17 terminals was installed and by October was ready for operation with students.

The CAI Laboratory was located in Bingham Junior High School in Southwest Kansas City. Bingham, which had been selected for its high reading level, was also beginning a program of modular scheduling. All eighth grade students (over 500 each year) were assigned two modules of

CAI each week. If terminals were available, students were also allowed to come in for additional CAI during their unstructured periods. The response of the students was so overwhelmingly enthusiastic that all terminals were in use every module.

The original plan was to develop a series of short, half-hour, single concept enrichment lessons. These lessons were to be supplementary to the regular math and science classes. Soon, however, it became obvious that many of the students did not possess the basic arithmetic skills required for success in the supplementary and enrichment lessons. Consequently, several remedial sequences in basic arithmetic with whole numbers, fractions, and decimals were developed out of necessity. Each of these lessons was designed such that a student would bypass a sequence if his performance on the pretest indicates he had already mastered the concepts involved, thus minimizing the time spent in remedial lessons. In response to requests from the math teachers, approximately 100 seventh grade students were also assigned these remedial arithmetic lessons in CAI.

By the beginning of the second year of operation with students, a large number of lessons had been developed. These were organized into three curriculum blocks each consisting of a remedial arithmetic lesson and two or three required lessons with several elective lessons related to each one. The students would begin each block at the same time, but several weeks later they would be scattered throughout the lessons in the block. No attempt was made to keep students together. Consequently, there was only a rough correspondence between topics in CAI and in the regular classroom.

Also, during the second year, project activities were expanded to include APL classes for high school students in the district and graduate students from UMKC. Four part-time college students were hired as coders to help the authors. Bingham teachers were invited to submit lessons for implementation via CAI. Their response was so overwhelming that the capacity of the system to service students was soon exceeded. Consequently, the project was forced to return to its original position of providing instruction in math and science only.

By the end of the second year, the major effort of curriculum development was subsiding and, with the uncertainty about funding, many of the staff members either left or were reassigned teaching positions within the district. Only a skeleton staff of a project director, three teacher-authors (who doubled as proctors and computer operators), one secretary, and one programmer were left to maintain the activities of the laboratory. In February of 1971 Federal funding expired because of a three-year limitation of aid to such projects. IBM offered the use of the 1500 system, rent free, for two years and, in spite of severe financial problems, the Kansas City, Missouri School District funded the rest of the project through 1971-72 with the provision that, if further funds became available, the system might be expanded to serve other schools. The project has had a very positive impact upon the community and much community effort has been expended to insure its continuation and expansion. (Kansas City, Mo. School District, 1971.)

## A Brief History of Wakulla County's CAI Project

The CAI project in Wakulla County, Florida began in July of 1968 and was also funded through Title III of the Elementary and Secondary Education Act. In contrast to Kansas City, Wakulla County is a very poor rural school district with a total enrollment of only 1800 students, and a population of 6,088 based on the 1970 census. The median number of school years completed by adults over 25 years of age is 8.2 years, and 54% of the families have an annual income of less than $3,000 (Hansen, Johnson, Durall, Lavin, & McCune, 1971). Standardized achievement test scores revealed that the average elementary school student in Wakulla County was 1.5 years below grade level. This project attempted to upgrade and maintain student achievement at a satisfactory level by providing individualized instruction via CAI. Two primary goals of the project were (1) to implement computer-assisted instruction in mathematics and reading for southern rural students, and (2) develop and implement oral language materials to add standard speech patterns to the colloquial speech patterns of these southern rural students.

Eight remote telecypes connected by telephone lines to an IBM 1500 system at Florida State University's CAI Center in Tallahassee were installed in Shadeville Elementary School and Medart Junior-Senior High School. The oral language program was begun in the fall of 1968 and, in the spring, CAI drill and practice reading and mathematics instruction was focused on all second and third-grade students in Shadeville Elementary School. In an effort to study the effects on student performance and cost reduction, the students were assigned to work at the terminals

in pairs. The following fall CAI was implemented on a full scale in all grades of Shadeville Elementary School and Medart High. The students were receiving three 15 to 25-minute sessions of CAI reading and mathematics per week. These drill and practice math lessons were directly keyed to the textbook, and designed to be completed in one sitting. An evaluation program was conducted each fall and again in the spring to determine the effects of the CAI and oral language materials. During the 1970-71 school year a program of computer-managed arithmetic based on standard textbook materials was developed and implemented in the seventh grade at Medart in response to a request from the onsite project staff.

There was considerably more university involvement in Wakulla's CAI project than there was in Kansas City. In particular, the project benefited from its proximity to Florida State University's CAI Center, and the consequent availability of a number of people who were already knowledgeable in the field of CAI. Also, FSU's CAI Center was responsible for the curriculum development, computer operations, and the evaluation of the project. The onsite staff consisted of a proctor at each school and one project director. The teacher and the proctor together decided what lesson should be presented to each student.

Wakulla County's CAI Project ceased in June of 1971, when the three years of Title III funding expired.

From the preceding brief summaries of each project, it is apparent that in spite of some vast differences in circumstances, there are still many similarities between the two installations. For the

purpose of the following comparisons, attention will be focused on their common subject matter area of junior high school mathematics. Regarding each of the major issues, there is a discussion of the approach taken by each project followed by recommendations for future CAI implementation efforts.

## Facilities

Kansas City was fortunate to have its own dedicated IBM 1500 system with 16 student stations and one proctor station. Each station consisted of a cathode ray tube (CRT) and a typewriter. Most of the lesson material was presented via the CRT which allowed graphic displays and simulated motion. Perhaps the greatest advantage of the CRT's is that they are faster and much quieter than typewriters. The typewriters were used to print out scores, directions, prescriptions, tables, and graphs. In general, any material the student might need to refer to during a lesson or that he should take with him was printed by the typewriter. Because of the proximity of the terminals to the central processor, the proctors could also double as computer operators, a situation which became necessary when the staff was reduced. Also, there was no lack of communication between the system staff and proctors due to distance.

The student terminals in Wakulla County were approximately 30 miles from the central processor (also an IBM 1500 Instructional System) at FSU's CAI Center. This distance prohibited the use of CRT's. To support the remote teletypes a Digital Equipment Corporation PDP-8 680 Communications System was interfaced to the IBM 1500 and telephone

communication lines were installed. The use of the less flexible teletype terminals restricts the presentation of instruction to primarily textual materials. Also, the time required to print material via teletype makes it inadvisable to present any lengthy text. The distance between the terminals and the central processor sometimes impeded communication both for humans and the hardware. It was not as easy for the proctors in Wakulla to report any terminal problems or needed course revisions as it was in Kansas City. As for the hardware communication problems, electrical storms or power fluctuations on the communication lines occasionally caused distortions in the signal being transmitted to the teletypes. It was difficult and time consuming to track down such problems.

Both installations were concerned about response time. The remote terminals in Wakulla were noticeably slower whenever there was a heavy use of the system for other courses at FSU's CAI Center. While Kansas City had a fairly constant number of terminals in use, response times varied greatly depending upon the number and type of lessons in use at a particular time. A warning mechanism was developed to notify the proctors whenever the response time exceeded a specified acceptable limit. The proctor could then take steps to alleviate the situation by asking authors to sign off, and preventing any further unscheduled use of terminals for that module. The systems staff also monitored the students' flow through the curriculum in order to distribute the heavily used lessons among several course packs, thus maximizing the number of disk drives in use at once. During the coding process care was taken to select strategies that would not only reduce response time, but also minimize the number of statements to save room on the course

packs. Frequently, it was necessary to compromise between these two opposing goals.

At both installations the voluminous student response records automatically generated by a 1500 system were recorded on tapes. FSU's CAI Center developed several data processing routines to summarize this information and also had available a CDC 6400 at the University's Computer Center for performing further analyses. Kansas City also developed its own set of data processing routines primarily for the purpose of identifying needed lesson improvements. Because of the extremely slow speed of the printer located on site, Hallmark Cards volunteered the use of its IBM 360 to transfer about 80,000 records per week from nine track to seven track tapes. Further analysis and printing was then done on the school district's 1401.

Anyone planning to implement a CAI program must make several decisions regarding the computer facilities. First, he must determine the kind of terminal devices needed to present his instructional materials. CRT's, typewriter, image projectors, light pens, and audio devices are all available. Once this decision has been made, the question of whether to have a dedicated onsite computer or remote terminal can be considered. The teletypes are not only slower and noisier, but they also limit the curriculum which can be presented. There are, however, situations in which it is necessary for the student to have a hard copy.

In determining the number of terminals to be installed, one must consider not only the number of students to be serviced, but also the effects on response time of a large number of simultaneous users.

Also, steps should be taken by coders and computer personnel to minimize response time and maximize the amount of course material available at any given time.

Wakulla County was able to benefit from data analysis routines in existence at FSU's CAI Center. Kansas City, on the other hand, developed its own routines. While one CAI project may not wish to totally adopt the entire data analysis programs in use at another center, they ought to at least attempt to put together a package to meet their needs from programs available at other centers with similar equipment in order to minimize duplication of effort.

## Staffing

The responsibilities of the project director in coordinating activities of teachers, proctors, authors, consultants, and evaluators place him in a position most crucial to the success of the project. Wakulla's experience of employing as director, a person naive with respect to CAI led to the recommendation that an autonomous director regardless of the availability of professional consultation and advice, should have a fairly comprehensive background in CAI (Hansen, et al., 1971). The director is in the most advantageous position to observe the onsite operations, answer questions immediately, and initiate needed changes. Kansas City, like Wakulla, employed a project director who was unfamiliar with CAI. However, during the planning phase and the long delay before initial funding, he was able to correct that situation before the project actually began. Of necessity, Kansas City's director had to

take the initiative in making decisions because there were no knowledgeable CAI people in the area for him to consult.

The system's staff available to each project consisted of a system's manager, a couple of programmers, and some computer operators. In Kansas City, the programmers, proctors, coders, authors, and secretaries all doubled as operators. Wakulla did not have its own systems staff since these services were provided by FSU's CAI Center. The systems staff should be familiar enough with the idiosyncracies of the instructional system to maximize its capabilities with respect to the number of students served, amount of course materials available at any one time, and optimum response time. In addition to writing programs to analyze student performance data, the systems staff may occasionally be called upon to design functions extending the capabilities of the coding language.

During the first year of operation in Kansas City, all authors were required to do their own coding in Coursewriter II. These people, who were originally hired as "typical classroom teachers" with little or no computer experienced, soon became proficient coders. It was eventually realized to be a tremendous waste of talent, however, for a person skilled at curriculum development to spend a large portion of his time sitting at a terminal typing. Consequently, four part-time college students were hired as coders the second year. It is important to note that the authors felt their coding experience was invaluable in helping them communicate with coders and design curriculum which capitalized on the system's potential. It would, therefore, seem advisable to include at least a small amount of coding experience in the training program for CAI curriculum

authors. Also, Kansas City found that its ratio of coders and authors (1:4) should be reversed. A prolific author writing full time could probably keep two full-time coders busy. In Wakulla County the responsibility of curriculum development fell upon part-time graduate students supported by coders at FSU's CAI Center.

Another important staff position in any CAI installation is that of the proctor. Kansas City did not identify any individual to serve solely as proctor. Instead, these duties were divided among the teacher-authors since the school district required that the proctor be a certified teacher. While again talented manpower was being wasted, some positive benefits accrued from this approach. Authors were able to locate trouble spots on the basis of the frequency of questions regarding a particular frame. Also, when problems arose, the author's familiarity with the curriculum and knowledge of Coursewriter II aided him in handling the situation. This ability allowed the proctors to correct minor problems on the spot.

Since most of the instructional decisions were incorporated into Kansas City's curriculum, the proctor's job was extremely easy, consisting mainly of taking attendance and answering just enough questions to justify his presence in the room and prevent him from concentrating on any other activity. Discipline problems were few since the student's attention was focused on the screen immediately in front of him, and therefore, not as easily distracted by disturbances elsewhere in the room. Also, carrel walls were arranged to discourage conversations between students.

The role of the proctor in Wakulla County was much more demanding and involved more public relations work. The curriculum was designed in such a way that the proctor was required to specify the lesson for every student when he came in. In other words, the instructional decision process was external to the computer. Theoretically, the teacher was consulted regarding the material each student was to receive. The need to interact with students, teachers, administrators, parents, consultants, and the computer terminals themselves made the role of the proctors in Wakulla more influential and extremely critical to the success of the project.

Of primary importance is the necessity for the proctor to be extremely familiar with the course material in order to answer questions or identify problems which might arise. He need only have enough facility with the instructional computer language to communicate errors to the coder and author. As will be discussed later in the section on curriculum, it would be desirable to relieve the proctor of as much decision making as possible by incorporating routine decisions into the instructional materials. This frees both the teacher and the proctor from a tedious duty and allows them to concentrate on those matters which the curriculum is not programmed to handle.

A somewhat elusive element is critical to the effectiveness of the staff for any similar project. That is, the degree to which each member feels committed to the project and ego-involved in its success. With the exception of the consultants from UMKC, Kansas City's staff were totally committed to the project with no other responsibilities

to the district. The fact that the entire staff was located in the same place, a prevading philosophy that each subunit be knowledgeable about the duties and responsibilities of every other subunit, and the overlapping of work assignments across subunits, all contributed to the cohesiveness of the staff effort. In contrast, Wakulla's staff were not only separated by distance, but many had other responsibilities and, thus, were not totally committed to this particular project. The desirable arrangement falls somewhere between these two extremes, probably tending toward the more practical Wakulla situation without sacrificing Kansas City's cohesiveness.

## Teacher Involvement

In neither project were the teachers extensively involved in CAI activities. Neither were the CAI lessons an integral part of the regular curriculum, a corollary phenomenon. In Wakulla teacher involvement consisted of releasing students from regular classroom activities to work on the terminals, and consulting with proctors regarding the lessons for each students.

Kansas City had even less teacher involvement due to an expressed feeling by the administration that the Bingham teachers were already overburdened by the adjustment to modular scheduling. The development of the remedial arithmetic lessons stirred some interest among the teachers. By the end of the first year of operation the project staff were becoming increasingly concerned that the Bingham teachers were not only uninvolved, but also unaware of the potential CAI had to assist them in the classroom. To remedy this situation the CAI staff offered a

workshop for the teachers to familiarize them with the available curriculum and inform them of the capabilities of the system. The following fall all Bingham teachers were invited to submit materials for implementation via CAI and subsequently superceded the capacity of the system with their requests.

The degree of teacher involvement is contingent upon the extent to which CAI and classroom instruction are intertwined. It is difficult, however, to justify the existence of a CAI system which is not handling at least some of the regular instruction. Consequently, it would be desirable to encourage teachers to incorporate CAI lessons into their classroom activities to a greater extent than the Kansas City or Wakulla teachers did.

## University-School District Relations

The University of Missouri at Kansas City (UMKC) provided several faculty members and a graduate student as consultants. Initially their role was to train the curriculum development staff and design an evaluation program. Later, CAI was included as a topic in a graduate course on developing programmed instructional materials. Another graduate course on APL was created and used the facilities at Bingham. The University, however, did not undertake any research involving the CAI project.

In contrast, Florida State University played a much more dominant role in Wakulla's CAI Project. The majority of the staff were employed by the University and had other responsibilities within it. Because of the existence of a group of people knowledgeable in CAI at Florida State,

much of the direction for Wakulla's project came from FSU's CAI Center. The University had initiated the project, supplied computer services, and was also responsible for curriculum development and project evaluation. Without university support, Wakulla's project would never have existed.

A CAI Center can exist without any university support and many will have to, due either to the distance between them or disinterest on the part of the nearby universities. Whenever such support is convenient and available it would seem wise to encourage university involvement at least on a consulting basis. Also, a university is an excellent source of talented personnel, particularly students who could serve as coders, proctors, computer operators, and curriculum designers. Not many universities would have their own CAI Center or core of individuals with experience in CAI, but they would undoubtedly have several people who would be interested in CAI. The university would benefit from its involvement because of the opportunity to conduct research and the ease of collecting data with an instructional computer system. Also, as UMKC did, a university could use the CAI project as either an object of, or a vehicle for, some of its courses.

## Curriculum

Initially Wakulla's CAI mathematics curriculum consisted of drill and practice lessons corresponding to the textbooks used in the classroom. Each day the proctor would specify a lesson for each student which he would then complete in one sitting. These lessons were arranged to maintain the lockstep of the classroom., By the winter of 1971 a computer-managed instruction (CMI) program was implemented in seventh-grade

mathematics. Individualized, self-paced auto-instructional units were developed, and tests and remedial sequences were coded for the computer. After studying the materials for a unit the student would sign on a terminal and take the test. If his score was less than 80% he would receive remedial instruction from either the computer or the teacher before taking the test again. Upon successful completion of the test he would move on to the next unit.

Kansas City's CAI materials may be divided into three categories of remedial, required, and elective lessons. The remedial lessons were three large basic skill sequences on whole numbers, fractions, and decimals. These lessons consisted of a pretesting mechanism which allowed the student to skip sections when he mastered the concepts involved, a series of tutorial frames for each objective culminated by a drill and practice sequence which also served as the posttest. There was no maximum time limit set for these lessons, and students would take anywhere from 20 minutes to several hours (20 minutes at a time) to complete them. These lessons were developed out of necessity when it was discovered that many students did not possess the basic skills necessary for them to succeed in the supplementary and enrichment lessons. Students who were in these remedial lessons for an undue length of time were assigned additional CAI periods until they finished, and their teachers were notified of their progress.

The required lessons established a theme for a set of related elective lessons and included such topics as exponents, scientific notation, ecology, velocity and acceleration, chemistry, geology, cells, and genetics.

An attempt was made to integrate math with science applications. These lessons were predominately tutorial in nature and had a maximum time limit of 100 minutes after which the student was branched out to new material. The elective lessons were similar to the required lessons except that they were much shorter single-concept sequences with a maximum time limit of only 45 minutes. Both the required and elective lesson topics were selected to correspond to but not duplicate the regular classroom instruction. However, since no attempt was made to keep the students together, several weeks could elapse between the time a topic was introduced in the classroom and the student encountered the related material in the CAI curriculum.

The lessons were organized into blocks of ten to fifteen weeks of materials (see Appendix A). Each block consisted of a remedial basic skill lesson, two required lessons and ten to twenty related elective lessons. After each major lesson, the student was allowed to select one of the elective lessons from a list which accumulated throughout the block. At the end of a block, the student continued taking electives until the new block was begun. No student ever saw all of the lessons in a block. A special program was written to direct students from lesson to lesson and allow students to select electives without any intervention by the proctor. A catalog describing each lesson was available to aid students in choosing electives. However, if for some reason it was necessary for the proctor to alter the normal course flow, a mechanism was available in every frame which allowed the proctor to branch the student to any other point in the block without reregistering him.

This same mechanism gave the student several useful options such as access to a glossary, the ability to make comments to the author, or the ability to make floating point arithmetic computations on-line by requesting calculator mode.

While Kansas City attempted to offer all of the instruction on-line, this approach required a lost of student terminal time and for some topics on-line presentatior is impractical. A more desirable strategy would be to combine facets of Kansas City's and Wakulla's curriculum into a package in which the computer would be programmed to diagnose entry behavior, prescribe instruction, and evaluate terminal behavior. Whether or not the instruction itself should be offered on-line is contingent upon the optimum trade-off between student time, terminal time, teacher time, and the cost of materials development. The computer should be programmed to manage the instructional process without requiring the intervention of the teacher or a proctor, but allow them the capability to alter the normal course flow if they deem it necessary. Also, the computer should be programmed to notify the proctor when an extreme case arises which the stored curriculum is not designed to handle. (It is not practical to include enough levels of remediation to handle every student.)

## Operations

All eighth grade students at Bingham Junior High in Kansas City were scheduled for two modules of CAI per week in addition to their regular classes. During their unscheduled modules they were allowed to

come in for additional CAI time if terminals were available. Upon entering the terminal room, students would immediately sign on and continue in whatever lesson they were in the session before. The proctor would announce the end of the module, and the students would sign off and leave. The student would not only be in the middle of a lesson, but frequently in the middle of a train of though when he was forced to leave. While Coursewriter II includes a mechanism for specifying logical restart points, the authors felt this was not sufficient to remind a student of the topics presented earlier in the lesson. Consequently, a review subroutine was developed to provide the student with an over-view of the lesson, or at least of the sections he had completed prior to continuing with the rest of the lesson. This strategy also provided the opportunity to retype directions, formulas, charts, etc. since it was unwise to assume that the student would have the printout from his last session with him. The teachers were given progress reports only for those students who were having difficulty with the remedial basic skills lessons. Several of the teachers then required these students to bring them the printout of their scores on each drill.

In Wakulla, the students were scheduled to work in a math lab which was adjacent to the terminal room. As the terminals became available, the students were called in to take their CAI lesson. The proctor selected a lesson for the student who was then presented with a series of problems covering the concept. At the end of a problem set the student's score was typed out, he was automatically signed off, and returned to the math lab.

Information regarding student progress should be made available to the teacher upon request, but only critical items demanding immediate action should be automatically provided. Too much routine data could bury the important facts.

## Results

Any empirical comparison between the two projects would be indefensible due to the differences in students and unequal treatment. The interpretation of the results of each project is further confounded since they both suffered from the lack of a comparable control group. Consequently, this section of the paper is of necessity fairly subjective and, therefore, merely summarizes the conclusions drawn by each project.

When the decision was made to include all eighth grade students at Bingham Junior High in the experimental CAI program, the planning staff attempted to compensate for the consequent lack of an equivalent control group by comparing the results with data collected on Bingham students from the previous year. However, the simultaneous introduction of modular scheduling nullified this effort as it was impossible to determine which innovation should be credited with contributing to any observed gains.

A study was run in the summer of 1969 to evaluate the effectiveness of the remedial math drills. Results significant beyond the .05 level were obtained to indicate that the drills are effectively increasing basic skills in mathematics as measured by the quantitative section of the Differential Aptitude Test.

In the spring of 1969, student attitude toward CAI was measured by a computer-administered scale included at a specified point in the curriculum. A pencil and paper version of the same scale was also administered. The results of both methods indicated that the students held a favorable attitude toward CAI. A breakdown of the computer-collected data revealed that the "faster" students (defined as the first 50% of the eighth grade to reach and complete the scale) had a slightly more positive attitude than the slower students. While the students always expresses a favorable attitude toward both CAI and the regular classroom situation, CAI consistently received a higher rating. (Kansas City, Mo. School District, 1970.)

Results in Wakulla indicated that across the board overall improvement in performance from fall 1968 to spring 1969 were attained with the most substantial increases reflecting the concentration of CAI treatment at the second and third grade level. These results were replicated during the 1969-1970 school year. During the 1970-1971 school year, an attempt to compare the CAI group at Shadeville with students at another elementary school in Wakulla County was confounded by desegregation efforts which mixed the experimental and control groups. No conclusions were drawn regarding the assignment of the students to work at the terminals in pairs rather than individually.

Data analysis for the fifteen weeks of CMI mathematics is not complete at present. There are indications that computer remediation produced little difference in performance among higher ability students. However, lower ability students tend to perform better under teacher

remediation. The computer remediated group had a more positive attitude toward the CMI mathematics program than the teacher remediated group.

## Conclusion

Both projects achieved their goals, but through very different means. Their experiences were particularly different with respect to staffing, (cohesive versus distributed), operations (required proctor intervention or optional intervention), and a philosophy of curriculum development (stand alone CAI and supportive CMI). Hopefully, this comparison highlights some issues which should be of concern in future development efforts. At the very least it emphasizes a need to visit more than one installation before forming an opinion of what CAI can and cannot do.

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